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Research Note

Calculating Lives Saved By Motorcycle Helmets

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Based on a comparison of fatal crashes involving motorcycles with two riders, at least one of whom was killed, NCSA has estimated helmets to be about 37 percent effective in preventing fatalities[1]. In 2003, there were 3,661 rider deaths in fatal motorcycle crashes. An effectiveness of 37 percent for motorcycle helmets suggests that an estimated 1,158 additional motorcyclists would have died were it not for the fact that they were wearing helmets. Had all motorcyclists consistently worn proper helmets, an additional 640 motorcyclists could have survived otherwise fatal crashes in 2003. Unfortunately, the potential life saving benefits of helmets are not being realized, as fatalities continue to rise in response to declining helmet usage rates. According to the most recent NOPUS survey, only 58 percent of motorcyclists nationally were observed to be wearing helmets. This represents a dramatic decline since 2000, when the usage rate was 71 percent.

Despite the fact that less than 3 percent of registered passenger vehicles are motorcycles, motorcyclist fatalities represent about nine percent of all passenger vehicle rider fatalities. Considering that passenger car rider fatalities are trending downward, policies that result in raising public acceptance of the protective value of helmets can have a significant impact on reducing the total number of lives lost annually on America's highways.

Periodically, The National Center for Statistics and Analysis (NCSA) of the National Highway Traffic Safety Administration (NHTSA) publishes an estimate of lives saved by various policies and strategies. This note describes the methodology used to calculate the contribution of motorcycle helmets to the total number of lives saved.

Calculation of Lives Saved

The starting point for estimating lives saved by helmets is to establish the effectiveness of helmets. In past years, NCSA has used a figure of .29 for effectiveness. This figure was based on cumulative fatal crash mortality data in the Fatality Analysis Reporting System (FARS) files from 1982 through 1987. In 2004, NCSA produced a revised estimate of .37 effectiveness based on more recent data to reflect changes that may have occurred in helmet materials and design since 1987[2]. The estimate of effectiveness is a composite of the separate effectiveness of helmets in protecting the lives of motorcycle operators and passengers.

If the total number of motorcyclists who died despite the protection of their helmets is known, then there must be a potential number of fatally injured helmeted motorcyclists that includes the number whose lives were spared due to their helmets. The number of lives saved (LS),

therefore, must be equal to Fatalities $_{Potential,}$ the potential fatalities, multiplied by the effectiveness:

LS= Fatalities $_{Potential}$ * .37

The number of potential fatalities is unknown, but we do know that the number of helmeted fatalities is equal to the number of potential fatalities reduced by the complement of the effectiveness or,

Fatalities $_{Helmeted}$= Fatalities $_{Potential}$ * (1-.37)

And Potential fatalities are:

Fatalities $_{Potential}$ = Fatalities $_{Helmeted}$ / (1-.37)

Returning to Lives saved, we now have:

LS = Fatalities $_{Potential}$ * .37

Or

LS = Fatalities $_{Helmeted}$ *.37/ (1-.37)

Now let us assume that we are living in an ideal society in which all motorcyclists take it upon themselves to wear proper helmets at all times while riding. How many lives would be saved with 100 percent compliance?

The number of potential lives saved (PLS) would equal the sum of the estimated lives saved and the total number of fatalities, both helmeted and unhelmeted, multiplied by the effectiveness of helmets:

PLS = (Fatalities $_{Total}$ + LS) * .37

Sample Calculations

The calculations are carried out using the effectiveness rates separately for operators and passengers, and then summing the results to obtain an estimate of lives saved that reflects a weighted average of the two effectiveness rates. The effectiveness for operators is estimated as .37, while the estimate for passengers is higher at .41. An example of the calculation using the 2003 FARS motorcyclist fatality data follows:

LS $_{Operators}$ = 1,805 (.37/(1-.37))

= 1,060

LS $_{Passengers}$ = 141 (.41/(1-.41))

= 98

And Total LS = 1,158

For Potential Lives Saved in 2003:

PLS $_{Operators}$ = (Fatalities + LS) $_{Operators}$ * .37

= (3,382 + 1,060) * .37

= 1,644

PLS $_{Passenger}$ = (Fatalities + LS) $_{Passengers}$ * .41

= (279 + 98) * .41

=154

And Total Potential Lives Saved = 1,798

The data used in the calculation are shown in Table 1

Table 1 - Lives Saved By Motorcycle Helmets In 2003

Motor Cyclists	Effec-tive-ness	Fatalities			Lives Saved	Potential Lives Saved
		Total	Hel-meted	Unhel-meted		
Operators	0.37	3,382	1,805	1,577	1,060	1,644
Passengers	0.41	279	141	138	98	154
Total	0.37	3,661	1,946	1,715	1,158	1,798

Impact on Estimates of Lives Saved

Although the method of estimating lives saved by helmets has not changed, adoption of the new effectiveness rate will tend to increase the estimates. Because it is

calculated from cumulative data over a ten-year period, the new rate's effect cannot be attributed to any particular year. To do so would cause a sudden "bump" in the time series data. In order to smooth out the series, the lives saved data for the years 1988 through 2003 will be recalculated using a wedging procedure to gradually introduce the change. Beginning in 1988, the number of lives saved is calculated by applying the new rate to one-sixteenth of the fatality data and the old rate to fifteen-sixteenths of the data. For succeeding years, the fractions are incremented and decremented by one-sixteenth until the new rate is used for the entire calculation in 2003.

Definitions

Of course, head injuries are not the only cause of crash fatalities. When we speak of "effectiveness" of helmets in reducing the risk of death in fatal motorcycle crashes, all types of injuries suffered by riders are included by implication. For example, if a helmet were absolutely certain to prevent a severe head injury, the rider could still die from other traumatic injuries suffered in a crash. Clearly, motorcycle helmets cannot prevent all fatal injuries. Just how effective helmets are in preventing fatalities is a function of both their performance in crashes and the incidence of fatal injuries other than head injuries.

Fatalities

In the calculation of lives saved, the definition of a fatality is the same as that used in the FARS database, that is, any motorcycle operator or passenger who dies within 30 days of the crash from injuries directly associated with the crash.

Motorcycles

Motorcycles are those vehicles described in FARS codes 80 through 89. These include motorcycles, mopeds, 3-wheeled cycles other than All Terrain Vehicles (ATVs); other" motorcycles; and motorcycles of unknown type. All of these body types are referred to collectively as motorcycles.

Motorcycle Riders

Motorcycle occupants, or riders, are either operators or passengers. In the FARS codes, motor vehicle occupants are composed of drivers, passengers of a motor vehicle in transport, or unknown occupants of a motor vehicle in transport. In the calculation of motorcycle riders' lives saved, the unknown occupants are distributed proportionately between motorcycle operators and passengers.

Helmeted and Unhelmeted

In calculating lives saved, the FARS variable REST_USE, (Restraint Use) is used to determine whether or not a motorcycle rider is helmeted. A rider is considered to be unhelmeted when coded either as 00 (None Used/Not Applicable) or 15 (Helmet Used Improperly). With the exception of unknowns, which were proportionally distributed, all other codes were interpreted as helmeted. This includes codes for safety belts and child safety seats. The assumption made is that the original investigator who filled out the Police Accident Report, or PAR, had used a restraint code to indicate that a helmet was worn. The number of cases that are coded in this manner is quite small, lending support to the assumption.

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References

1. The method was first used at NHTSA in 1988. See: Evans, Leonard and Frick, Michael. "Helmet Effectiveness in Preventing Motorcycle Driver and Passenger Fatalities: Accident Analysis and Prevention", U.S. Department of Transportation, National Highway Traffic Safety Administration, Volume 20, Number 6, 1988.

2. National Center for Statistics and Analysis, Motorcycle Helmet Effectiveness Revisited, NHTSA Technical Report DOT HS 809 715

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